

1 16. A hand held pointing device for a computer system, the pointing device comprising:

3 a housing having a bottom surface that moves against a desktop surface;

5 the housing also having a top surface shaped to receive the human hand;

7 the housing also having a skirt connecting a perimeter of the bottom surface with the
9 top surface;

11 the housing also having a first axis extending generally in the direction from where the
13 heel of the hand rests on the top surface to where the middle finger rests on the top surface, and
15 a second axis perpendicular to the first, both axes parallel to the bottom surface;

17 an aperture in the bottom surface;

19 a source of non-coherent illumination mounted within the interior of the housing,
21 proximate the aperture, that illuminates, from a single location and with an angle of incidence in
23 the range of about five to twenty degrees, a portion of the desktop surface opposite the aperture
25 and having surface height irregularities forming a micro texture with feature sizes in the range of
27 about five to five hundred microns, the illumination producing highlights upon surface height
29 irregularities that extend out of the desktop surface and that intercept the illumination and shadows
upon surface height irregularities that extend into the desktop surface and whose illumination is
blocked by adjacent surface height irregularities that are illuminated, the highlights and shadows
forming a pattern that varies as a function of rotations and translations of the aperture relative to
the desktop;

an optical motion detection circuit mounted within the interior of the housing and
optically coupled to the highlights and shadows from the surface height irregularities of the
illuminated portion of the desktop surface, the optical motion detection circuit producing motion
signals indicative of motion in the directions along the first and second axes and relative to the
surface height irregularities of the illuminated portion of the desktop surface; and

wherein the optical motion detection circuit comprises a plurality of photo detectors
each having an output, a memory containing a reference frame of digitized photo detector output
values and a sample frame of digitized photo detector output values obtained subsequent to the
reference frame, and further wherein a plurality of comparison frames, each being a shifted version
of one of the reference frame or the sample frame, is correlated with the other of the reference
frame or the sample frame to ascertain motion in the directions along the first and second axes.

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1 ~~17.~~ A1 A hand held pointing device as in claim ~~16~~ wherein the optical coupling is performed by a lens.

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1 ~~18.~~ A1 A hand held pointing device as in claim ~~16~~ wherein the optical coupling is performed by a mirror.

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1 ~~19.~~ A1 A hand held pointing device for a computer system, the pointing device comprising:
3 a housing having a bottom surface that moves against a work surface;
the housing also having a top surface shaped to receive the human hand;
the housing also having a skirt connecting a perimeter of the bottom surface with the
5 top surface;

the housing also having a first axis extending generally in the direction from where the
heel of the hand rests on the top surface to where the middle finger rests on the top surface, and
a second axis perpendicular to the first, both axes parallel to the bottom surface;

an aperture in the bottom surface;

a source of illumination mounted within the interior of the housing, proximate the
aperture, that illuminates a portion of the work surface opposite the aperture and having surface
height irregularities forming a micro texture with feature sizes in the range of about five to five
hundred microns, the illumination producing a pattern of highlights upon surface height
irregularities that extend out of the desktop surface and that intercept the illumination and of
shadows upon surface height irregularities that extend into the desktop surface and whose
illumination is blocked by adjacent surface height irregularities that are illuminated;

an optical motion detection circuit mounted within the interior of the housing and
optically coupled to the pattern of highlights and shadows from the surface height irregularities
of the illuminated portion of the work surface, the optical motion detection circuit producing
motion signals indicative of motion in the directions along the first and second axes and relative
to the surface height irregularities of the illuminated portion of the work surface;

wherein the optical motion detection circuit comprises a plurality of photo detectors
each having an output, a memory containing a reference frame of digitized photo detector output

values and a sample frame of digitized photo detector output values obtained subsequent to the
reference frame, and further wherein a plurality of comparison frames, each being a shifted version
of one of the reference frame or the sample frame, is correlated with the other of the reference
frame or the sample frame to produce a corresponding plurality of correlation values and ascertain
motion in the directions along the first and second axes; and

an arithmetic comparison mechanism coupled to the plurality of correlation values, and
wherein the motion signals are not output to the computer system whenever a correlation surface
described by the plurality of correlation values fails to exhibit a selected curvature.

20. A hand held pointing device for a computer system, the pointing device comprising:

a housing having a bottom surface that moves against a work surface;

the housing also having a top surface shaped to receive the human hand;

the housing also having a skirt connecting a perimeter of the bottom surface with the
top surface;

the housing also having a first axis extending generally in the direction from where the
heel of the hand rests on the top surface to where the middle finger rests on the top surface, and
a second axis perpendicular to the first, both axes parallel to the bottom surface;

an aperture in the bottom surface;

a source of illumination mounted within the interior of the housing, proximate the
aperture, that illuminates a portion of the work surface opposite the aperture and having surface
height irregularities forming a micro texture with feature sizes in the range of about five to five
hundred microns, the illumination producing a pattern of highlights upon surface height
irregularities that extend out of the desktop surface and that intercept the illumination and of
shadows upon surface height irregularities that extend into the desktop surface and whose
illumination is blocked by adjacent surface height irregularities that are illuminated;

an optical motion detection circuit mounted within the interior of the housing and
optically coupled to the pattern of highlights and shadows from the surface height irregularities
of the illuminated portion of the work surface, the optical motion detection circuit producing
motion signals indicative of motion in the directions along the first and second axes and relative
to the surface height irregularities of the illuminated portion of the work surface;

wherein the optical motion detection circuit comprises a plurality of photo detectors
each having an output, a memory containing a reference frame of digitized photo detector output
values and a sample frame of digitized photo detector output values obtained subsequent to the
reference frame, and further wherein a plurality of comparison frames, each being a shifted version
of one of the reference frame or the sample frame, is correlated with the other of the reference
frame or the sample frame to produce a corresponding plurality of correlation values and ascertain
motion in the directions along the first and second axes; and

an arithmetic comparison mechanism having inputs coupled to the motion signals and
wherein the motion signals are not output to the computer system whenever the motion signals
indicate a velocity that exceeds a preselected limit.

21. A hand held pointing device for a computer system, the pointing device comprising:

a housing having a bottom surface that moves against a work surface;
the housing also having a top surface shaped to receive the human hand;
the housing also having a skirt connecting a perimeter of the bottom surface with the
top surface;

the housing also having a first axis extending generally in the direction from where the
heel of the hand rests on the top surface to where the middle finger rests on the top surface, and
a second axis perpendicular to the first, both axes parallel to the bottom surface;

an aperture in the bottom surface;

a source of illumination mounted within the interior of the housing, proximate the
aperture, that illuminates a portion of the work surface opposite the aperture and having surface
height irregularities forming a micro texture with feature sizes in the range of about five to five
hundred microns, the illumination producing a pattern of highlights upon surface height
irregularities that extend out of the desktop surface and that intercept the illumination and of
shadows upon surface height irregularities that extend into the desktop surface and whose
illumination is blocked by adjacent surface height irregularities that are illuminated;

an optical motion detection circuit mounted within the interior of the housing and
optically coupled to the pattern of highlights and shadows from the surface height irregularities
of the illuminated portion of the work surface, the optical motion detection circuit producing

motion signals indicative of motion in the directions along the first and second axes and relative to the surface height irregularities of the illuminated portion of the work surface;

wherein the optical motion detection circuit comprises a plurality of photo detectors each having an output, a memory containing a reference frame of digitized photo detector output values and a sample frame of digitized photo detector output values obtained subsequent to the reference frame, and further wherein a plurality of comparison frames, each being a shifted version of one of the reference frame or the sample frame, is correlated with the other of the reference frame or the sample frame to produce a corresponding plurality of correlation values and ascertain motion in the directions along the first and second axes; and

a switch disposed on the skirt in a location underneath the right thumb or the left ring finger of a hand grasping the pointing device, that is coupled to the optical motion detection circuit and that inhibits the output of the motion signals to the computer system when the hand activates the switch by squeezing against the skirt in a plane parallel to the bottom surface in order to lift the pointing device away from the desktop surface.

22. A hand held pointing device for a computer system, the pointing device comprising:

a housing having a bottom surface that moves against a work surface;
the housing also having a top surface shaped to receive the human hand;
the housing also having a skirt connecting a perimeter of the bottom surface with the top surface;

the housing also having a first axis extending generally in the direction from where the heel of the hand rests on the top surface to where the middle finger rests on the top surface, and a second axis perpendicular to the first, both axes parallel to the bottom surface;

an aperture in the bottom surface;

a source of illumination mounted within the interior of the housing, proximate the aperture, that illuminates a portion of the work surface opposite the aperture and having surface height irregularities forming a micro texture with feature sizes in the range of about five to five hundred microns, the illumination producing a pattern of highlights upon surface height irregularities that extend out of the desktop surface and that intercept the illumination and of

15 shadows upon surface height irregularities that extend into the desktop surface and whose
illumination is blocked by adjacent surface height irregularities that are illuminated;

17 an optical motion detection circuit mounted within the interior of the housing and
19 optically coupled to the pattern of highlights and shadows from the surface height irregularities
of the illuminated portion of the work surface, the optical motion detection circuit producing
21 motion signals indicative of motion in the directions along the first and second axes and relative
to the surface height irregularities of the illuminated portion of the work surface;

23 A1 wherein the optical motion detection circuit comprises a plurality of photo detectors
each having an output, a memory containing a reference frame of digitized photo detector output
values and a sample frame of digitized photo detector output values obtained subsequent to the
25 reference frame, and further wherein a plurality of comparison frames, each being a shifted version
of one of the reference frame or the sample frame, is correlated with the other of the reference
frame or the sample frame to produce a corresponding plurality of correlation values and ascertain
27 motion in the directions along the first and second axes; and

29 a switch disposed on the skirt in a location underneath the left thumb or the right ring
finger of a hand grasping the pointing device, that is coupled to the optical motion detection circuit
and that inhibits the output of the motion signals to the computer system when the hand activates
31 the switch by squeezing against the skirt in a plane parallel to the bottom surface in order to lift
the pointing device away from the desktop surface.
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